Week 9

GUI Lists

This week

- Packages
- ListView
- Opening and closing windows
- Controls
- Change listeners

Packages

Packages

- A package is a collection of related classes.

- Each application or library should be placed in its own package.

- To avoid two programmers using the same package name for their application, we follow a convention:
  - Companies use the reverse of their domain name.
    e.g. For domain name **`mycompany.com`**, use the package name **`com.mycompany`**
  - Different applications made by the same company are in sub-packages.
    e.g. **`com.mycompany.calculatorapp`** and **`com.mycompany.studyapp`**

Packages

- Complex applications are further divided into sub-packages.

- e.g. in an MVC application, you may have 3 sub-packages:
  - **`com.mycompany.studyapp.model`** contains the domain model classes
  - **`com.mycompany.studyapp.view`** contains the views
  - **`com.mycompany.studyapp.controller`** contains the controller classes

Package declarations

- Declare a class in a package with a package declaration:

```
package com.mycompany.bankapp.model ;

public class Account {
    ...
}
```

- On the file system, sub-packages map onto sub-directories.
  e.g. the `Account` class is stored in the corresponding sub-directory:

```
com/mycompany/bankapp/model/ Account.java
```

ListView

ListView‹X›

- A ListVew<X> displays a list of items of type X.

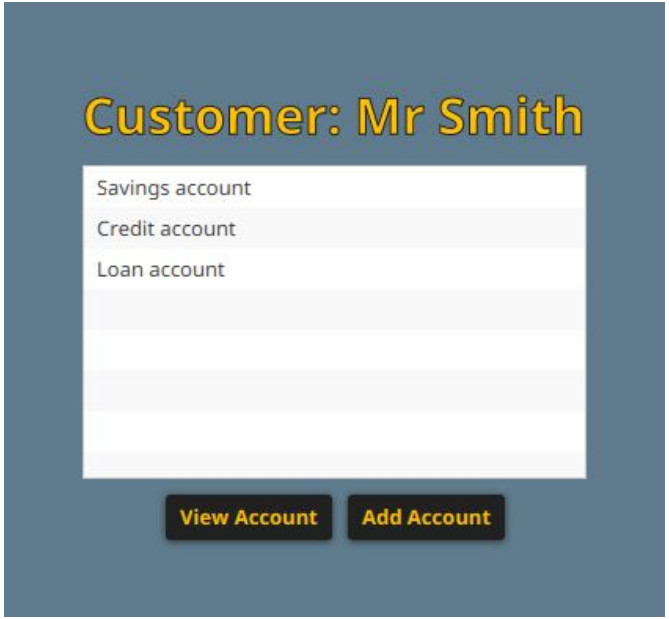
- Items can be either:
  - Strings
  - Objects that have a toString() function

- Create a ListView in FXML:

```
<ListView fx:id="accountsLv"/>
```

- Create a ListView in Java:

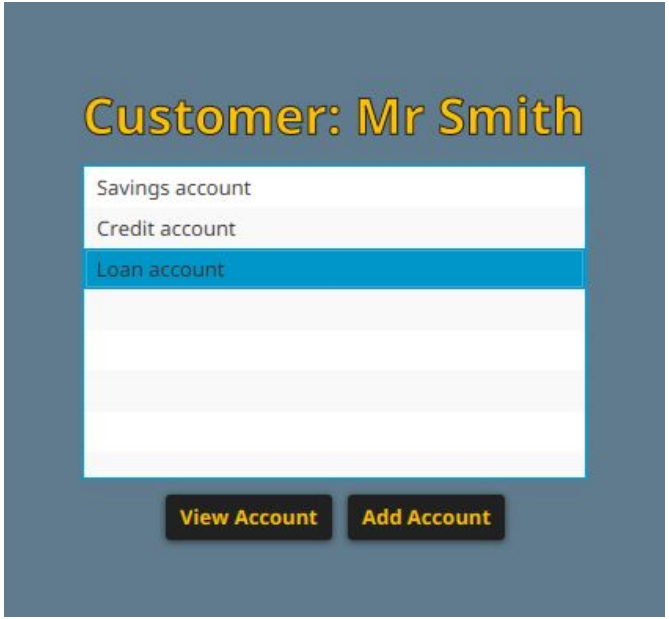
```
ListView<Account> accountsLv = new ListView<Account>();
```



ListView Selection Models

- ListViews support two selection models:
  - SINGLE selection (the default model)
  - MULTIPLE selection
- In both selection models:
  - Clicking an item selects that item
  - The previously selected item is also deselected
- In the multiple selection model:
  - Shift-click or control-click to select multiple items
- If your application requires multiple selection:

```
listView.getSelectionModel().setSelectionMode(SelectionMode.MULTIPLE);
```



Setting a placeholder

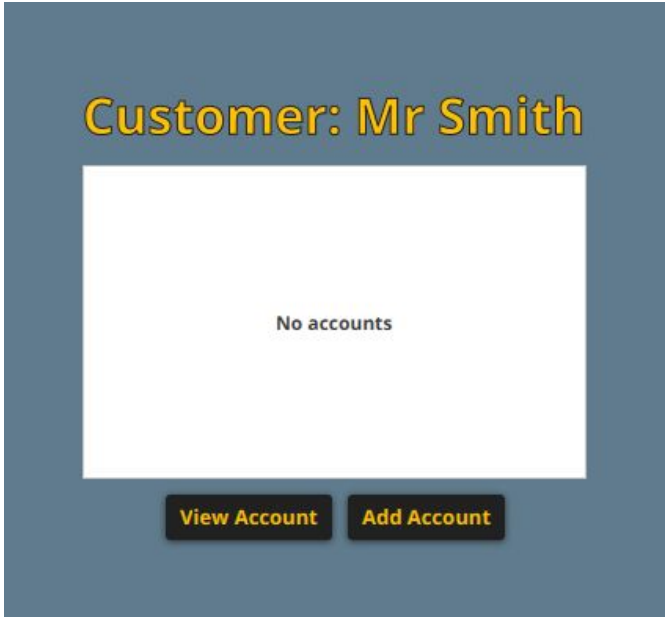
- A placeholder node is shown when the ListView is empty.

- In FXML:

```
<ListView>
    <placeholder>
        <Label text="No accounts"/>
    </placeholder>
</ListView>
```

- In Java:

```
accountsLv.setPlaceholder(new Label("No accounts"));
```



Setting preferred dimensions

- In FXML:

```
<ListView prefWidth=" 300" prefHeight=" 200"/>
```

- In Java:

```
accountsLv.setPrefWidth( 300);
accountsLv.setPrefHeight( 200);
```

Linking a ListView to the model

- **Goal**: Whenever the model changes the view is updated.

```
public class Customer {
  private LinkedList<Account> accounts = new LinkedList<Account>();

  public void addAccount(String type) {
    accounts.add(new Account(type));
  }
}
```

We must notify the ListView that
a new Account was added to the list.

Linking a ListView to the model

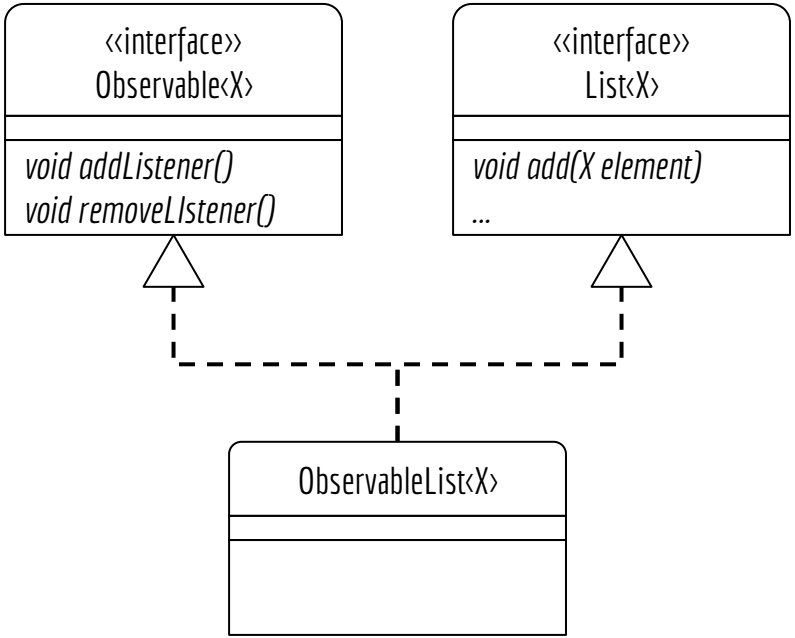
- **Solution**: Use an ObservableList

```
public class Customer {
  private ObservableList<Account> accounts = FXCollections.
observableArrayList();

  public void addAccount(String type) {
    accounts.add(new Account(type));
  }
}
```

- Observers are notified whenever the list contents changes.

ObservableList “is a” relationships



Linking a ListView to the model

- Define the observable list as an immutable property with mutable state:

```
public class Customer {
    private ObservableList<Account> accounts = ...;
    public final ObservableList<Account> getAccounts() { return accounts;
}
}
```

- Bind the “items” property of ListView to the accounts property of customer
  - In FXML: `<ListView items=”${controller.customer.accounts}”/>`
  - In Java: `accountsLv.setItems(customer.getAccounts());`

Selecting a ListView item

Selecting a ListView item

Goal: The user selects an item from a ListView then clicks a button to perform an action on the selected item.

Solution: Set the onAction handler for the button to perform the following two steps:

1. Get the selected item (pattern)
2. Perform an action on that item

ListView getter pattern

- A `ListView` has a getter that gets the currently selected item.
- It uses the `getSelectedItem()` method of the selection model.

```
public class CustomerController {
    @FXML private ListView<Account> accountsLv;

    private Account getSelectedAccount() {
        return accountsLv.getSelectionModel().getSelectedItem();
    }
}
```

Example: View the selected account

FXML file:

```
<ListView fx:id="accountsLv"/>
<Button text="View Account"  onAction="#handleViewAccount" />
```

Controller:

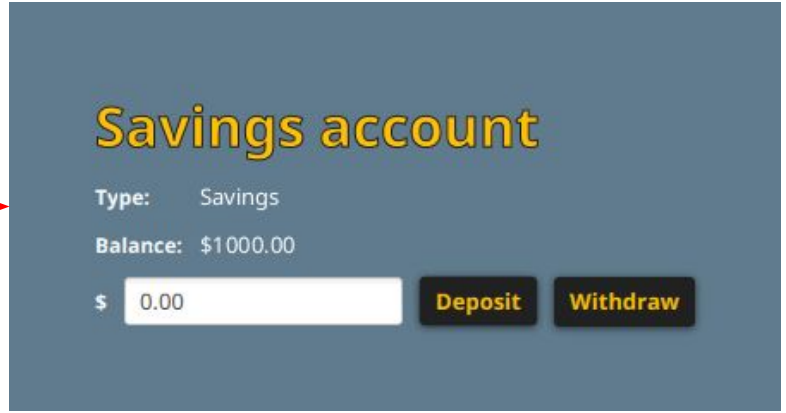
```
public class CustomerController {
    @FXML private ListView<Account> accountsLv;
    private Account getSelectedAccount() {
        return accountsLv.getSelectionModel().
getSelectedItem();
    }
    @FXML private void handleViewAccount(ActionEvent event) {
        Account account = getSelectedAccount();
        System.out.println("You selected: " + account);
    }
}
```

If `accountsLv` is clicked when no item is selected, `getSelectedAccount()` returns `null`.

Opening a window

Opening a window

Click
View Account



Opening a window

- In MVC, each window requires 3 components:

	View	Controller	Model
Customer window:	customer.fxml	CustomerController	Customer
Account window:	account.fxml	AccountController	Account

- To open a new window:
  - Load the view from FXML (this in turn creates the controller)
  - Link the controller to the appropriate model
  - Create a new Stage, and show the view's scene graph on the stage

Opening a window

- UTS provides a package to help opening windows:

```
import au.uts.edu.ap.javafx.*;
```

- The ViewLoader class simplifies the process of showing a window:

```
ViewLoader.showStage(<model>, <fxml>, <title>, <stage>);
```

The model object

The FXML file

The window title

The stage

Source code for ViewLoader

```
package au.edu.uts.ap.javafx;
public class ViewLoader {
  public static <T> void showStage(T model, String fxml, String title, Stage stage)
      throws IOException {
    FXMLLoader loader = new FXMLLoader(Controller.class.getResource(fxml), null, null,
                type -> {
                     try {
                          Controller<T> controller = (Controller<T>)type.newInstance();
                          controller.model = model;
                          controller.stage = stage;
                          return controller;
                     } catch (Exception e) { throw new RuntimeException(e); }
                });
    Parent root = loader.load();
    stage.setTitle(title);
    stage.setScene(new Scene(root));
    stage.sizeToScene();
    stage.show();
  }
}
```

The model and stage are automatically “injected” into the controller.

ViewLoader examples

- Show a customer on the primary stage:

```
public class BankApplication extends Application {
  @Override public void start(Stage stage) throws Exception {
    Customer customer = new Customer("Mr Smith");
    ViewLoader.showStage(customer, "/view/customer.fxml", "Customer",
stage);
  }
}
```

- Show an account on a new stage (new window):

```
ViewLoader.showStage(account, "/view/account.fxml", "Account",  new Stage());
```

Making controllers compatible with ViewLoader

- In the same helper package is an abstract `Controller` class:

```
package au.edu.uts.ap.javafx;

public abstract class Controller<X> {
    protected X model;
    protected Stage stage;
}
```

- If your controller extends this class, it will inherit the `model` and `stage` fields. `<X>` is the type of the model being used.

- `ViewLoader` will try to inject the model and stage into these fields.

Providing a model property

- Every controller extends Controller and exposes a property for the model.

```
public class CustomerController extends Controller<Customer> {
    public final Customer getCustomer() { return  model; }
}

public class AccountController extends Controller<Account> {
    public final Account getAccount() { return  model; }
}
```

- The model is automatically injected into the inherited `model` field.
- Use Property Pattern #4: Immutable Property with Mutable State.
  i.e. Provide a final getter. It returns the model.

Example: CustomerController

```
public class CustomerController extends Controller<Customer> {
  @FXML private ListView<Account> accountsLv;
  public final Customer getCustomer() { return model; }
  private Account getSelectedAccount() {
    return accountsLv.getSelectionModel().getSelectedItem();
  }
  @FXML private void handleViewAccount(ActionEvent event) {
    Account account = getSelectedAccount();
    ViewLoader.showStage(account, "/view/account.fxml", "Account",  new
Stage());
  }
}
```

- Upon clicking the button, show `/view/account.fxml` and injected the selected account into the account controller.

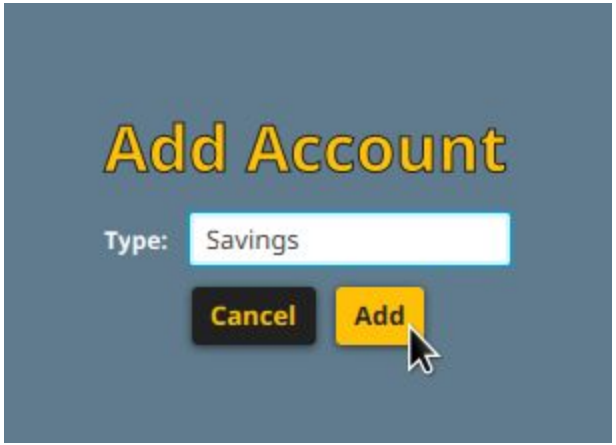
Example: AccountController

```
public class AccountController extends Controller<Account> {
  @FXML private TextField amountTf;
  public final Account getAccount() { return model; }
  private int getAmount() { return Integer.parseInt(amountTf.getText()); }
  private void setAmount(int amount) { amountTf.setText("" + amount); }
  @FXML private void handleDeposit(ActionEvent event) {
    getAccount().deposit(getAmount());
    setAmount(0);
  }
  @FXML private void handleWithdraw(ActionEvent event) { ... }
}
```

- The model field holds the selected account.
- Use getAccount() to access the account.

Closing a window

Closing a window



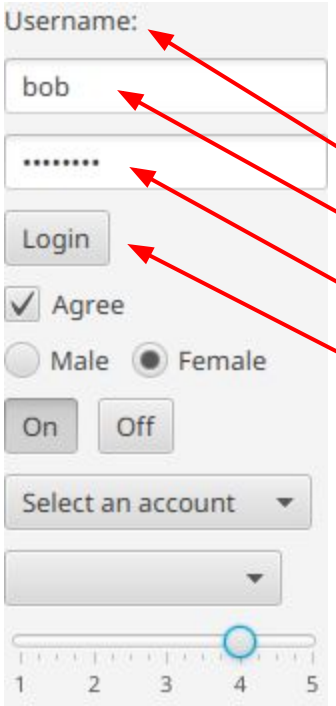
Closing a window

- Close a window with `stage.close()`.
- Every subclass of `Controller<X>` inherits a `stage` field.
  Therefore, any method within a controller can call `stage.close()`.

```
public class AddAccountController extends Controller<Customer> {
    @FXML private String nameTf;
    public final Customer getCustomer() { return model; }
    private String getName() { return nameTf.getText(); }
    @FXML public void handleAdd(ActionEvent event) {
        getCustomer().addAccount(getName());
        stage.close();
    }
}
```

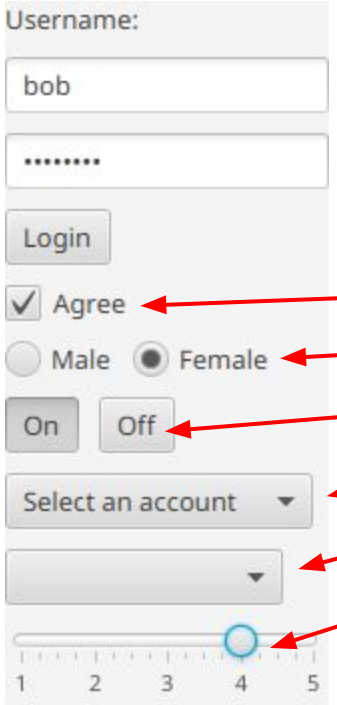
JavaFX controls

JavaFX controls



- JavaFX controls are nodes that tend to appear in forms.
- We have already seen:
  - `Label`
  - `TextField`
  - `PasswordField`
  - `Button`

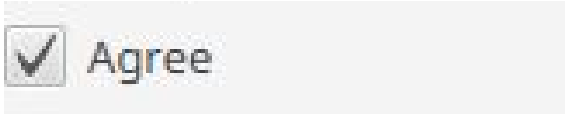
More controls



- JavaFX also supports:
  - `CheckBox`
  - `RadioButton`
  - `ToggleButton`
  - `ComboBox`
  - `ChoiceBox`
  - `Slider`

For more, see: https://docs.oracle.com/javase/8/javafx/user-interface-tutorial/ui_controls.htm

CheckBox



- A `CheckBox` is either selected or not.
- FXML: `<CheckBox text="Agree" fx:id="agreeCb"/>`
- Controller: `@FXML private CheckBox agreeCb;`
- `CheckBox` properties:
  - `selected`: indicates whether the `CheckBox` is currently selected.
- e.g.

```
if (agreeCb.isSelected())
    System.out.println("User agrees");
```

RadioButton

- Related `RadioButton`s are placed in a `ToggleGroup`. Only one `RadioButton` in the group can be selected at a time.
- FXML:

```
<fx:define><ToggleGroup fx:id="genderTg"/></fx:define>
<RadioButton text="Male" userData="m" toggleGroup="$genderTg"/>
<RadioButton text="Female" userData="f" toggleGroup="$genderTg"/>
```

- Controller: `@FXML private ToggleGroup genderTg;`
- Properties of `RadioButton`
  - `text`: the text to display
  - `userData`: the raw data (e.g. to store in the model, or a database)
- Properties of `ToggleGroup`
  - `selectedToggle`: the `RadioButton` that is currently selected
- e.g.

```
String genderUserData = genderTg.getSelectedToggle().getUserData();
System.out.println("The user selected: " + genderUserData);
```

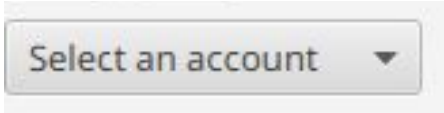
ToggleButton

- Behaves the same way as a `RadioButton`.

- FXML:

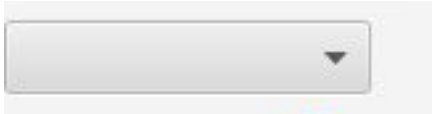
```
<fx:define><ToggleGroup fx:id="musicTg"/></fx:define>
<ToggleButton text="On" userData="on" toggleGroup="$musicTg"/>
<ToggleButton text="Off" userData="off" toggleGroup="$musicTg"/>
```

ComboBox



- A `ComboBox` shows a popup list of items with a prompt.
- FXML:
```
<ComboBox fx:id="accountsCmb" promptText="Select an account"
          items="${controller.customer.accounts}"/>
```
- Controller: `@FXML private ComboBox accountsCmb;`
- `ComboBox` properties are similar to `ListView` properties:
  - `items`: defines the list of items to display.
  - `selectionModel`: represents the selection state.
- e.g. `Account account = accountsCmb.getSelectionModel().getSelectedItem();`

ChoiceBox



- A `ChoiceBox` shows a popup list of items *without* a prompt.
- FXML: `<ComboBox fx:id="accountsChb" items="${controller.customer.accounts}"/>`
- Works the same way as a `ComboBox`.

Slider

- A `Slider` shows a thumb that can be slid on a track.

- FXML:

```
<Slider min="1" max="5" showTickMarks="true" showTickLabels="true"
        majorTickUnit="1"/>
```

For more, see:
https://docs.oracle.com/javase/8/javafx/user-interface-tutorial/ui_controls.htm

Getter/Setter patterns for controls

- It is good practice to define getters and setters to wrap the contolled value. E.g.

```
private String getGender() {
    return genderTg.getSelectedToggle().getUserData();
}
private boolean isAgree() {
    return agreeCb.isSelected();
}
private Account getAccount() {
    return accountsCmb.getSelectionModel().getSelectedItem();
}
```

Change listeners

Change listeners

- **Goal**: Be notified whenever an observable value changes.
- **Examples**:
  - Be notified when the text in a `TextField` changes.
  - Be notified when the selected item of a `ComboBox` changes.
  - Be notified when the selected toggle of a `ToggleGroup` changes.
- **Solution**: Register an observer that implements the `ChangeListener<X>` interface, where `<X>` is the type of value observed.

```
import javafx.beans.value.*;
public interface ChangeListener<X> {
    void changed(ObservableValue<? extends X> observable,
                 X oldValue, X newValue);
}
```

- Register the observer with `observable.addListener(observer);`

Any property can be observed for changes

- Print the account balance whenever it changes:

```
account.balanceProperty().addListener((obs, oldBal, newBal) ->
    System.out.println("Balance changed from "+oldBal+" to "+newBal)
);
```

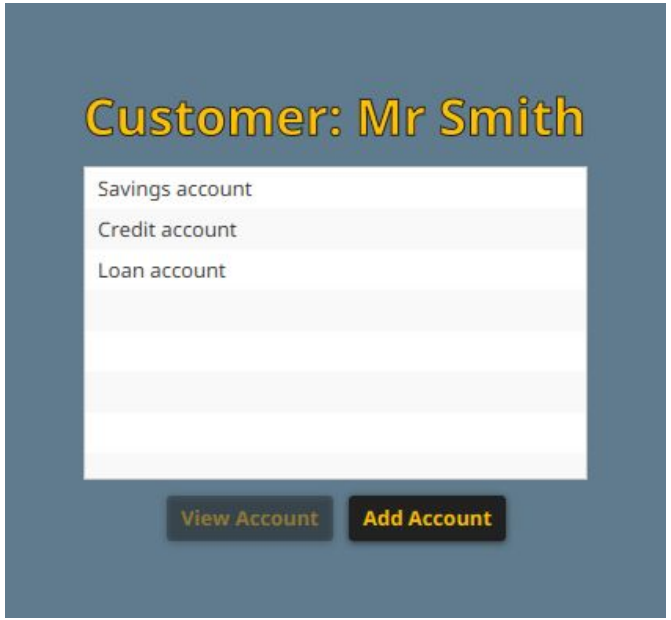
- Print the text of a TextField whenever it changes:

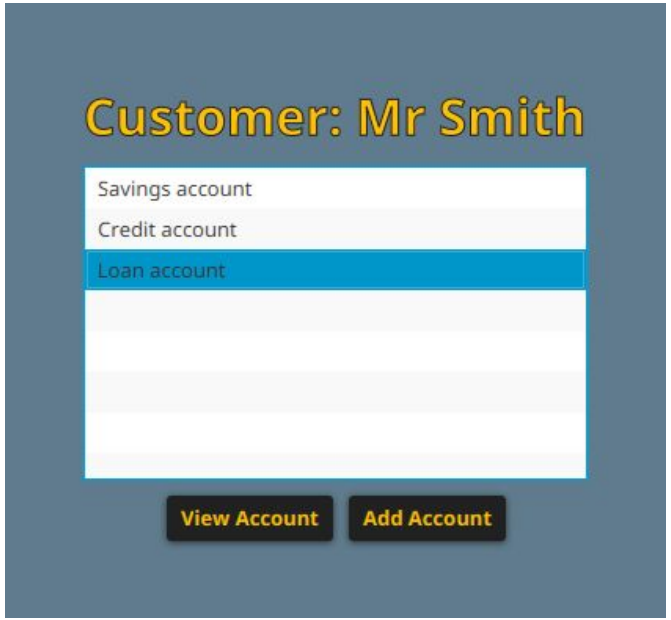
```
nameTf.textProperty().addListener((obj, oldText, newText) ->
    System.out.println("Text updated to " + newText)
);
```

- Print the selected account whenever it is selected:

```
accountsLv.getSelectionModel().addListener((o, oldAcct, newAcct) -> {
    if (newAcct != null) // if an account was selected
        System.out.println("You selected " + newAcct);
});
```

Example: Enable button when account is selected





Solution

- FXML:

```
<ListView fx:id="accountsLv" items="${controller.customer.accounts}"/>
<Button fx:id="viewAccountBtn" text="View Account"  disable="true"
        onAction="#handleViewAccount"/>
```

- Controller:

```
@FXML private void initialize() {
  accountsLv.getSelectionModel().selectedItemProperty().addListener(
    (observable, oldAccount, newAccount) ->
      viewAccountBtn.setDisable(getAccount() == null));
}
```

- This makes use of two properties:
  - Register a ChangeListener to the **`selectedItem`** property of the selection model.
  - When the selection changes, update the **`disable`** property of the Button.